

## THE CHITON FAUNA OF THE KERMADEC ISLANDS.

By TOM IREDALE.

*Read 12th December, 1913.*

## PLATES I, II.

DURING 1908 I collected all the Chitons I could at Sunday Island in the Kermadec Group. Towards the end of 1907 my friend Mr. A. F. Basset Hull visited Lord Howe Island, one of his main objects being the collection of Chitons. Near the end of the succeeding year he made a trip to Norfolk Island, again one of his chief interests being this group of molluscs. Early in 1909 when passing through Sydney we examined each other's collections, since the zoology of these three localities has long been a theme for comparison. I proposed to withhold the results of my own studies until Mr. Hull's paper was published, since he had been first in the field. Having critically examined many Chitons at the British Museum, I included in some notes in this journal (vol. ix, pp. 160-2, 1910) a brief account of the habits and relationship of the forms I procured at the Kermadecs, making allusion to Mr. Hull's collection.

In the study of the Lord Howe and Norfolk Island Chitons Mr. Hull was assisted by Mr. Hedley, and their conclusions have recently been published (*Proc. Linn. Soc. N.S.W.*, vol. xxxvii, pp. 271-81, 1912). As above noted, I profited by the interchange of specimens, but recently I have acquired very large collections of the Lord Howe and Norfolk Island species, made by my friend and companion collector at the Kermadecs, Mr. Roy Bell. These large collections enable me to deal very completely with the relationships of the species found at each group, and I therefore propose to divide this paper into two sections, the first being a systematic and descriptive account of the Kermadec Island Chitons, the second a comparative review of the Chitons of the three localities previously named.

## 1. SYSTEMATIC ACCOUNT.

The classification here utilized is based upon that proposed by Dr. J. Thiele in his "Revision des Systems der Chitonen", published in Chun's *Zoologica*, 1909-10. Hitherto most workers have made use of that introduced by Pilsbry in his memorable monograph of this group in the *Manual of Conchology*, vols. xiv and xv (part), 1892-4. Pilsbry's exposition was so brilliantly effected that it inaugurated a new era in the study of the group: based upon conchological characters easily grasped by any painstaking student, the work was so thoroughly done that improvement seemed impossible, more especially as the results of intricate investigations were so clearly expressed. As a matter of fact, for absolutely fifteen years it received no practical amendment; yet during the whole of that time work was being very assiduously carried on, the whole of this work being

entirely due to the impetus given to collectors by Pilsbry's masterly and most lucid treatment of the group. As stated above, Pilsbry's monograph was entirely a conchological one, and the few apparent discrepancies were not easily corrected by the study of the shells alone.

Dr. Thiele, in his Revision, through the co-ordinate study of the radular characters, has remedied some of these inconsistencies; the Revision is primarily constructed upon Pilsbry's monograph, and in the majority of cases full value has been given to conchological features. There can be no hesitation in accepting Thiele's Revision as a great advance upon the classification introduced by Pilsbry, and I hope, through the study of large quantities of Australasian material, to effect some improvements upon Thiele's Revision. My criticism of Thiele's Revision has been mainly conchological, so that it is most pleasing to find that we are so much in accord. In the succeeding pages I propose several amendments, and it is well to state that these proceed from the study of much Australasian material in conjunction with my Kermadec specimens. My earlier notes in these Proceedings concerning Australasian Chitons dealt mainly with the identification and nomination of species. In this paper I give more attention to the higher groupings, but also take the opportunity of correcting some errors occurring in those notes.

As Dr. Thiele's Revision may not be generally available to readers of these Proceedings, I would note here the groupings referring to the Kermadec Chitons thus:—

<i>Sub-order.</i>	<i>Family.</i>
Lepidopleurina.	Lepidopleuridæ.
	{ Callochitonidæ.
	{ Mopaliidæ.
Chitonina.	{ Cryptoplacidæ.
	{ Ischnochitonidæ.
	{ Chitonidæ.

I have not altered any of these family groupings, but give reasons for differing from both Thiele and Pilsbry as regards the genera utilized, and I am still continuing my researches in this direction. The notes given in quotation marks after the station of the species are extracts from my paper in this journal above noted, and are here introduced so that correlation with the previously unnamed species can be made.

## Order POLYPLACOPHORA.

### Sub-order LEPIDOPLEURINA.

#### Family LEPIDOPLEURIDÆ.

##### Genus PARACHITON.

*Parachiton*, Thiele: Chun's Zoologica, Heft lvi (Revision des Systems der Chitonen), pt. i, p. 14, 1909.

Type (by monotypy): *Lepidopleurus acuminatus*, Thiele.

At the place quoted Thiele described *Lepidopleurus acuminatus* from Duke of York Island. He introduced *Parachiton* as a sub-generic name to be used on account of certain peculiar features, one of which

was the extraordinary tail-valve. He referred the species to the genus *Lepidopleurus*, mainly on account of the lack of insertion-plates. I had already concluded that the genus *Lepidopleurus* was polyphyletic, and now anticipate its dismemberment as material becomes available. I had determined to remove the following species from *Lepidopleurus* before I recognized that it was certainly a second member of Thiele's sub-genus *Parachiton*. That fact at once compelled me to advocate the recognition of Thiele's sub-genus as worthy of full generic rank, and its inclusion in the family Lepidopleuridæ is simply due to the fact that insertion-plates are absent. I believe that the division of the Polyplacophora into the sub-orders Lepidopleurina and Chitonina is artificial, and that further study will lead to the disintegration of the former and the transference of the present members of it to various families of the Chitonina.

PARACHITON MESTAYERÆ, n.sp. Pl. I, Fig. 1.

Shell elongate, faintly keeled, elevated, side-slopes slightly convex, *last valve disproportionately large*, girdle spiculose. General coloration pink, slashed with longitudinal white streaks. Anterior valve regularly quincuncially punctate. Median valves narrow, not beaked, first very slightly larger than the others; lateral areas little raised, the sculpture regular quincuncial punctation; the pleural areas are closely longitudinally striate, the striation becoming finer as it approaches the dorsal ridge, where, however, it still persists. Posterior valve much larger than the anterior valve; the micro elevated at about the posterior fourth, the posterior area being concave. The anterior portion is triangular, its length twice as long as the preceding valve; it is similarly sculptured to the pleural areas of the median valves, whilst the posterior area is regularly quincuncially punctate, the punctation showing clearly on account of the protection afforded by the concavity of this area. Inside coloration pinkish-white. Insertion-plates absent. The sutural laminæ small, irregularly quadrangular, and very far apart. The girdle, owing to the difficulty of preserving, appears somewhat imperfectly covered with very slender elongate needles, with a fringe of much longer silvery spicules.

A minute curled juvenile specimen shows the same sculpture as the adult; the quincuncial punctation appears more prominently, and the longitudinal striæ more pronounced. Length of type 11, breadth 6 mm. A much larger specimen curled up before it could be preserved.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—Dredged off the north coast on gravelly bottom in 15 fathoms; also in Denham Bay in 25 fathoms. "From 15 to 25 fathoms was dredged a fine *Lepidopleurus*, which has no near relation yet on record. It faintly resembles some Japanese species."

*Remarks.*—This is undoubtedly most nearly allied to *Lepidopleurus acuminatus*, Thiele, but otherwise no other shell is comparable. *L. acuminatus*, Thiele, has the apex of the posterior valve more posterior, and consequently the posterior area more diminished.

I have associated with this beautiful Chiton the name of my friend Miss M. K. Mestayer as a mark of her interest in this group.

GENUS LEPIDOPLEURUS.

*Lepidopleurus*, Risso: Hist. Nat. l'Eur. Mérid., vol. iv, p. 267, 1826.

Type (by subsequent selection by Pilsbry, 1892), *Chiton cajetanus*, Poli.

I am quite unable to accept the following species as a typical *Lepidopleurus*, and therefore designate it as the type of a new sub-genus.

LEPIDOPLEURUS (TERENOCHITON, n.subgen.) SUBTROPICALIS, n.sp.

Pl. II, Figs. 10, 17.

Shell small, elongate oval, highly keeled, side slopes straight and steep, girdle scaly. General coloration uniform, pale reddish-yellow to brick; two specimens blackish-brown. Anterior valve flattened, with the apex elevated and slightly recurved, the anterior slope being faintly concave; the sculpture consists of minute pustules, arranged in very close radial rows. Median valves have their lateral edges almost straight, but somewhat raised; the sculpture of the lateral areas, which are differentiated by a slight fold, is simply pustulose, with no defined arrangement; the pleural areas are sculptured with slanting longitudinal rows of separated tubercles; from the edge of the valve ten rows can be counted before they become ill-defined and merging on the dorsal area. Posterior valve small, with the mucro anterior and elevated, the lateral slope concave. Sculpture as in the median valves. Inside coloration white. Insertion-plates absent. Sutural laminae low and broad, higher towards the outer edges of the valves, sinus broad. Girdle densely covered with minute striated scales.

The preceding description is drawn up from a medium-sized specimen, selected as type. Minute juvenile specimens show the anterior valve, lateral areas of median valves, and posterior area of posterior valve to be simply pustulose, without any defined arrangement of the pustules, whilst the pleural areas of the median valves are sculptured with few well-defined longitudinal rows of tubercles, and the dorsal area is almost smooth. In an old crassate individual the pustules have developed into raised tubercles upon the anterior and posterior valves, and the dorsal area is strongly irregularly tuberculose, the longitudinal rows of the pleural areas showing indistinctly through the strong tubercles massing and somewhat merging. Length of type 6.5, breadth 4, size of largest specimen 8 by 4.5 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—Living on the underside of embedded dirty stones below low-water mark. Only procured at Coral Bay on the east coast. "A small *Lepidopleurus* was living under dirty stones below low water. It was only on the underside of stones deeply embedded."

*Remarks.*—This little species recalls *Lorica* in miniature, and cannot well be confused with any other Australasian Chiton. Its nearest relations are *Lepidopleurus norfolcensis*, Hedley & Hull, from Norfolk Island, and *L. catenatus*, Hedley & Hull, from Lord Howe Island. The authors note the relationship of the latter, but do not compare the former, which they contrast with the New South Wales *L. badius*, Hedley & Hull. With the type of *Lepidopleurus* these small species have nothing in common save the absence of insertion-plates. I am therefore introducing the new sub-generic name *Terenochiton*, with *L. subtropicalis*, Iredale, as type, and would for the present include all the small Australasian '*Lepidopleurus*' under this heading, though I can see little direct affinity between the present species and the Neozelanic *L. inquinatus* (Reeve).

### Sub-order CHITONINA.

#### Family CALLOCHITONIDÆ.

##### Genus EUDOXOCHITON.

*Eudoxochiton*, Shuttleworth, Mittheil. naturf. Gesell. Berne, p. 191, 1853.

Type (by monotypy), *Acanthopleura nobilis*, Gray.

The genus *Eudoxochiton*, placed by Pilsbry in the family Chitonidæ, has been transferred by Thiele to his family Callochitonidæ, and in this latter disposition I have already expressed (Proc. Malac. Soc., vol. ix, p. 153, 1910) my concurrence.

##### EUDOXOCHITON PERPLEXUS, n.sp. Pl. I, Figs. 4, 6, 8.

Shell large, oval, *elevated*; valves arched, side slopes almost straight; girdle leathery, with short spinelets. Colour uniform reddish-brown, girdle greenish-brown. The only sculpture is minute punctulation, though indistinct radiation may sometimes be observed on the anterior valve, whilst growth-lines are commonly seen on the central areas. Anterior valve comparatively small. Median valves narrow, lateral areas well raised. Posterior valve with the mucro elevated at about the anterior third, the posterior slope slightly concave. Inside coloration pure white. Anterior valve has the insertion-plate very short, and cut into about twenty-three teeth, which are irregularly deeply pectinated. Median valves with sutural plates continuous, the sinus only indicated by a shallow depression. Insertion-plates short, with three or four teeth as in anterior valve. Posterior valve faintly emarginate on the posterior border, the insertion-plate very short and not projecting beyond the tegmentum. About twenty-three slits can be counted, the teeth as in anterior valve. Girdle leathery, covered with short brown spinelets. Length of type 59, breadth 40 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—On rocks about low tide.

## EUDOXOCHITON IMITATOR, n.sp. Pl. I, Figs. 5, 7, 9.

Shell large, oval, *depressed*; valves slightly keeled, side slopes straight, girdle leathery with short spinelets. General coloration uniform dark-brown, girdle pale greenish-brown. Sculpture as in preceding species. Contrasted with the foregoing species the valves are more depressed, posterior valve with mucro planate, almost central. Inside coloration pure white. Sutural laminae longer than in the above species, and the sinus even less pronounced. Insertion-plates longer, and the anterior valve with more than twenty-five teeth, the posterior about twenty-two. Girdle leathery, with short brown spinelets. Length of type 59, breadth 40 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—On rocks below low tide.

“*Eudoxochiton* is endemic in Neozelanic waters with two distinct species. *E. nobilis*, Gray, lives on the surf-swept boulders, and its form and internal characters are well suited to withstand the force of the waves. *E. huttoni*, Pilsbry, is easily separated by its much more depressed form and longer teeth, it is only found on the most exposed situations, and would appear to be much rarer. Which is the parent or to which would the parent form be more like would be difficult to suggest. The question is more complicated by the finding on Sunday Island of two forms of *Eudoxochiton*. . . . The *Eudoxochitons* of Sunday Island are very puzzling, as the existence of two forms on such a small island I could scarcely credit myself. Yet the shells seem easily separable into two lots, which might be classed as varieties of *nobilis*, Gray; they differ in general form as much from each other as from that species and are both less elevated. One form is even lower than *huttoni*, Pils., though in the characters and number of the teeth it absolutely agrees with the other. I have so far been unable to provide a satisfactory explanation for the differentiation of these from each other and from the *Eudoxochitons* of New Zealand.”

*Remarks.*—I have here admitted the two forms above indicated as distinct species, and would fully note the differences observed. *E. perplexus* was first collected, and it was noted as being less elevated than *E. nobilis* (Gray), though quite unlike *E. huttoni*, Pilsbry. Collectors of *Eudoxochiton* well know the rarity of the genus, and very few specimens were obtained. Valves were not uncommonly met with on the beach, and examination of these constantly gave the number of slits in the interior and posterior valves as about twenty-two or twenty-three. The notes I had with me (copied from Pilsbry) gave—

*E. nobilis*, Gray, anterior valve 30 slits; posterior 24–5 slits.

*E. huttoni*, Pilsbry .. .. 17 .. .. 19 ..

This seemed to indicate that the Kermadec shell was not *nobilis* (I had not specimens with me for actual comparison), and it was certainly not *huttoni*.

In the winter the sand moved along the north coast and forced a large number of *Eudoxochiton* to come up to low-water mark. This unexpected opportunity was greedily seized to collect every specimen,

and it was then found that the majority of these differed in their depressed form and darker coloration, which was noticeable at sight. Moreover, they were beautifully clean specimens such as had never been collected before. In New Zealand even the smallest specimens of these Chitons are covered with ugly extraneous growths, and the earlier collected Kermadec specimens were dirty and worn. I have now concluded that this depressed form must be a deeper water dweller. It is easily separated from *E. perplexus* by its depressed form, different posterior valve, and longer teeth, whilst the coloration is also darker. It cannot be confused with either *E. nobilis* (Gray) or *E. huttoni*, Pilsbry, and, on account of its pseudo-resemblance to the latter, I have called it *E. imitator*.

There would seem to be grounds for supposing the depressed form to be the oldest, as juveniles of all four species are very flattened and scarcely determinable. The girdle is simply leathery with a crinkled appearance, with only signs of the short spinelets thereon. I have juveniles of the Kermadec species which I would not definitely distinguish, since I do not think they could be easily differentiated from juveniles of *E. nobilis* (Gray), which I collected in the South Island of New Zealand. It is certain that the Kermadec species are smaller than the New Zealand ones, the valves being comparatively broader and the girdle comparatively narrower. The largest Kermadec specimen is under 70 mm. long and 45 mm. broad, whilst an average-sized Neozelanic *E. nobilis*, Gray, measures 75 mm. long by 50 mm. broad, and specimens 110 mm. in length are known to exist. These measurements are taken from specimens with the girdle well preserved and flattened.

### Family MOPALIIDÆ.

#### Genus PLAXIPHORA.

*Plaxiphora*, Gray, Proc. Zool. Soc. Lond., 1847, pp. 65, 68, 169.

Type (by monotypy), *Chiton carmichaelis*, Gray = *Ch. auratus*, Spalowsky.

In the *Manual of Conchology*, vol. xiv, p. 311, Pilsbry divided the genus *Plaxiphora* into two sub-genera, *Plaxiphora* and *Placophoropsis*. I would separate these generically. Pilsbry then indicated three sections of his sub-genus *Plaxiphora*, viz. *Plaxiphora* (s.str.), *Guildingia*, and *Frembleya*. Thiele (Revision, p. 116) admits two genera, *Plaxiphora* and *Frembleya*, noting no sections.

*Guildingia* I would generically differentiate, as the solitary species is well defined and cannot be confused with anything else; the valves are distinctive, whilst the radula seems to differ. The type of *Plaxiphora* is *Chiton auratus*, Spalowsky, and this species is well characterized by its large size, the lack of sculpture, the nature of the girdle, and the form of the posterior valve. The Neozelanic *Plaxiphora campbelli*, Filhol, with which *P. aucklandica*, Suter (Subant. Islands New Zeal., vol. i, Mollusea, p. 2, pl. i, fig. 1, 1909), based upon a juvenile, is synonymous, is typical.

*Plaxiphora biramosa* (Quoy & Gaimard) is quite unlike the preceding, though of large size. The exterior of the valves (which are very solid) is sculptured, whilst the sutural laminae are connected, a feature otherwise quite foreign to the genus, and the posterior valve is quite differently formed. I consider this species quite worthy of sub-generic distinction, and I propose for it the new sub-generic name DIAPHOROPLEX.

The group typified by *P. costata* (Blainville) is also easily diagnosed by the medium size of the members, the sculptured exterior of the valves, and the formation of the posterior valve. Study of Pilsbry's Manual (loc. cit.) suggested the use of *Euplaxiphora*, Shuttleworth, for this group, but reference to Shuttleworth's paper (Mittheil. naturf. Gesell. Berne, 1853) showed that this name was introduced (p. 193) in such a manner that it can only be treated as a substitute name for *Plaxiphora*, Gray, and is therefore unavailable. I propose to designate this sub-generic group PONEROPLAX and to name *Chiton costatus*, Blainville, as type.

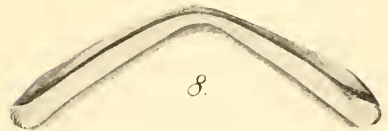
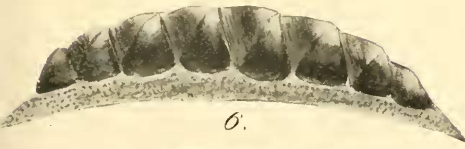
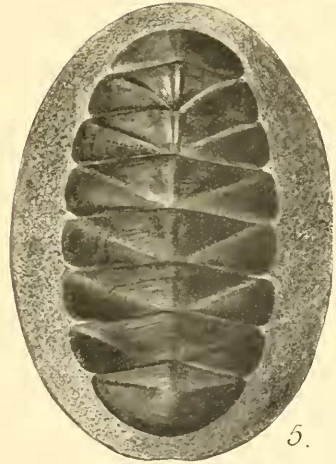
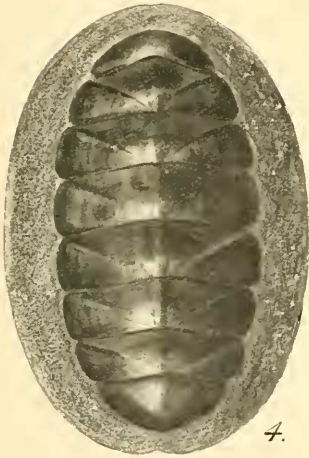
*Frembleya*, founded upon *P. egregia*, H. & A. Adams, has been admitted as a section by Pilsbry and as a distinct genus by Thiele. I would temporarily rank it as a sub-genus, the sculpture, small size, and peculiar posterior valve being diagnostic. The commonest *Plaxiphora* in New Zealand is *P. calata* (Reeve), under which name more than one species appears to be confused. The small size, definite sculpture, and peculiar posterior valve determine this sub-genus; the tegmentum of the posterior valve ends in a pointed plane mucro forming a triangle. I propose for this sub-genus, naming *Chiton calatus*, Reeve, as type, MAORICHITON.

My conclusions regarding the division of the Australasian *Plaxiphora* are as follows:—

Genus	<i>Guildingia</i> , Pilsbry.	Type	<i>G. obtecta</i> (Pilsbry).
,,	<i>Plaxiphora</i> , Gray.	,,	<i>P. aurata</i> (Spalowsky).
Sub-genus	<i>Plaxiphora</i> , Gray.		
,,	<i>Diaphoroplax</i> (supra).	,,	<i>P. biramosa</i> (Q. & G.).
,,	<i>Poneroplax</i> (supra).	,,	<i>P. costata</i> (Blainville).
,,	<i>Frembleya</i> , H. & A. Adams.	,,	<i>P. egregia</i> (H. & A. Ad.).
,,	<i>Maorichiton</i> (supra).	,,	<i>P. calata</i> (Reeve).

The question may be raised whether this subdivision is necessary and will it be useful. To the first, I would point out that it tends to exactness and certainly makes work more facile and identifications more certain. To the second, I say emphatically that it will be most useful, especially to the zoogeographer, and I give the following notes. The genus *Plaxiphora* is admittedly Antarctic in its distribution. The typical sub-genus occurs in the Falkland Isles, Southern South America, the Sub-Antarctic Islands of New Zealand commonly, and the mainland more rarely. It does not occur in Australia. The sub-genus *Diaphoroplax* is, so far as I know, confined to New Zealand, as is the genus *Guildingia*. The sub-genus *Poneroplax* occurs throughout Australia, and possibly *P. frembleii*, Broderip, should be referred here. The species "*P. glauca*, Q. & G."





*Roland Green del.*

CHITONS FROM THE KERMADEC ISLANDS.



has been recorded from the Chatham Islands, but it is doubtful whether this identification be correct. Thiele has recently described *P. schauinslandi* from that locality, and this species does not belong to the sub-genus *Poneroplax*, but to the sub-genus *Maorichiton*. The sub-genus *Frembleya*, founded upon a New Zealand species, wrongly ascribed to Australia, appears to have a representative on that continent in my *P. matthewsi*. The sub-genus *Maorichiton* is typically Neozelanic, but it seems to include the small *Plaxiphora* recently described from South Africa and Ceylon.

Thiele has given excellent figures of the fifth and posterior valves of all these *Plaxiphora*, and I propose to give similar figures, elucidating the above classification, in a paper now in preparation. The species of *Plaxiphora* collected at the Kermadec Islands belongs to the sub-genus *Maorichiton*.

PLAXIPHORA (MAORICHITON) MIXTA, n.sp. Pl. II, Figs. 12, 15, 16, 18.

Shell small, elongate, somewhat elevated, valves keeled and beaked, girdle densely hairy. Coloration generally black, white, and green. Some specimens agree most accurately with E. A. Smith's description of his *C. terminalis* as regards coloration; sometimes dark blue with white markings; rarely rich brown with white markings; girdle always green. Anterior valve with eight radiating ribs not much elevated, and between each rib wrinkled V-sculpture. Median valves with the lateral area bounded on both sides by strong raised, somewhat nodulous ribs, between which appears a transversely wrinkled or V-sculpture; the pleural areas sculptured with irregular fine wavy longitudinal ridges, more pronounced at the edges, and becoming very fine on the dorsal area. Posterior valve triangular with the mucro terminal, and the posterior area reduced to raised ribs; the anterior portion sculptured like the pleural areas of the median valves. Inside coloration deep blue-green. Anterior valve with projecting insertion-plate, with grooved, widely spaced, somewhat irregular teeth; the slits eight in number. Median valves with projecting insertion-plate with one slit; sutural laminae widely placed apart and whitish in colour, inside as well as out. Posterior valve with no insertion-plate, but a callused semicircular ridge, which is much exceeded by the pointed tegmentum. Girdle densely covered with long hairs, which are somewhat longer and bunched at the pores. Young specimens show the sculpture to be much stronger in the juvenile, the pleural areas of the median valves having well-marked and deep longitudinal ridges, and the lateral areas are bounded by heavy, somewhat nodulous ribs. The majority of adult specimens are covered with marine growths, and the tegmentum is much eroded. Length of type 32, breadth 15mm.

*Hab.*—Sunday Island, Kermadec Group (type); ?Macauley Island, Kermadec Group.

*Station.*—At Sunday Island it was rarely found in crevices of rocks between tide marks. I collected a few specimens at Macauley Island in deep rock pools between tides, but I am not satisfied that these are identical with the one here described.

*Remarks.*—In sculpture and form this shell is closely allied to *P. calata* (Reeve), differing at sight in the girdle characters.

Thiele (Revision, p. 23), meeting with Neozelanic *Plaxiphora*, has indicated the differences between *P. calata* (Reeve) and a young *Plaxiphora* from Lyttelton, New Zealand, and has also named the Chatham Island species *P. schauinslandi*. When I discussed Australasian *Plaxiphora* (Proc. Malac. Soc., vol. ix, pp. 92–100, 1910) I had no Lyttelton specimens before me. I had largely collected there, and receiving specimens I at once dissected some, and found them to agree with Thiele's description. When I collected them it was with much misgiving that I associated all my small *Plaxiphora* together as *P. calata* (Reeve). That species, determined by *P. terminalis* (Smith), was much larger, more elevated, differently coloured, with different shape and different girdle characters, whilst it lived lower down. Thiele's shell is the very common smaller shell living near high-water mark and always much eroded. A new name is not needed, as I would unhesitatingly identify the latter with *Tonicia zigzag*, Hutton (Trans. N.Z. Inst., vol. iv, p. 181, 1872), and it should be known as

#### PLAXIPHORA (MAORICHITON) ZIGZAG (Hutton).

The Kermadec species is allied to the true *P. calata* (Reeve) and not to *P. zigzag* (Hutton).

#### Family CRYPTOPLACIDÆ.

Thiele has amalgamated Pilsbry's two families Acanthochitidæ and Cryptoplacidæ under the latter name, admitting two sub-families of practically the same dimensions and names. He also admits as distinct genera *Cryptoconchus* and *Acanthochites*, a course I fully endorse. I note this here, as a valve which would seem referable to *Cryptoconchus* was found by Mr. Roy Bell in a rock pool on the east coast. Valves of two species of *Acanthochites* were met with in dredgings; both were minute, but no complete specimen was procured.

#### Family ISCHNOCHITONIDÆ.

##### Genus ISCHNOCHITON.

*Ischnochiton*, Gray, Proc. Zool. Soc., 1847, pp. 127, 168.

Type (by subsequent designation, Gray, 1847), *Chiton textilis*, Gray.

Thiele subdivides this genus in a somewhat conservative manner, recognizing three sub-genera, *Ischnochiton*, *Stenoplax*, and *Chondropleura*. Under the first he places with sectional rank only *Ischnoradsia*, *Stenochiton*, and *Heterozona*; the other divisions do not interest Australasian students. None of these, however, should admit *Stenochiton* as of sectional value only, whilst I should prefer *Ischnoradsia* given at least sub-generic rank. As, however, the Kermadec species is referable to *Ischnochiton*, s.str., I will defer discussion of the Thielean classification until I deal with species of *Ischnoradsia* at a later date.

## ISCHNOCHITON KERMADECENSIS, n.sp. Pl. I, Fig. 3.

Shell small, elongate, slightly elevated; valves faintly keeled; girdle scaly. Coloration varied: commonly olivaceous of various shades, sometimes splashed with lighter or darker; commonly brownish, with a brick wash fading to dirty yellow, sometimes splashed with lighter or darker markings, rarely with an uniform dorsal broad light stripe; frequently with lighter markings down the back extending on to some valves so as to recall the var. *picturatus* of *I. smaragdinus*; no specimens with the markings of the var. *decoratus* of *I. crispus*, Reeve, though similar markings occur in the Neozelanic *I. longicymba*, Quoy & Gaimard, not Blainville = *I. maorianus*, n.sp. Other colorations and variations occur more rarely. Anterior valve faintly but closely radiately ribbed. Median valves with the lateral areas small, but similarly sculptured; pleural areas finely quincuncially punctate. Posterior valve with the posterior area sculptured as the anterior valve, the anterior area as the pleural areas of the median valves. Internal coloration generally greenish-blue, but varying somewhat according to the external coloration. Anterior valve has the smooth insertion-plate variously slit, apparently the number of slits varying with age; at least, I am unable to separate the shells specifically, though dissections give the following results: anterior 13 slits, posterior 12 slits; ant. 9, post. 8; ant. 12, post. 12; ant. 11, post. 10; ant. 12, post. 9; ant. 12, post. 11 slits. The shells with the *largest* number of slits are the *smallest*, whilst the shells with the *fewest* slits are the *largest*. This is exactly the opposite to my anticipations regarding insertion-plate slitting. I am still engaged in the study of this variation in the slitting, and have made many dissections with no definite result as yet. Median valves have the sutural laminae short, broad, and placed far apart, the insertion-plate with one slit, the posterior tooth quite unlike either that of *I. crispus* (Reeve) or *I. maorianus* (= *I. longicymba*, auct.). In some cases it is longer than in others, but in all cases it is shorter than in the former, though longer than in the latter. Posterior valve with insertion-plate very short, and variously slit as above noted. Girdle covered with very minute regularly striated scales. Juvenile shells show a completely punctate surface, no radial ribbing being observed either on the anterior and posterior valves, or on the lateral areas of the median valves. As above noted, the slits in the anterior and posterior insertion-plates seem to be more numerous in this stage and decrease with age. Length of type 18, breadth 9 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—On the underside of clean smooth stones below low tide marks. "On smooth stones just below low-water lived species . . . of *Ischnochiton*, of the *crispus*, Reeve, group."

*Remarks.*—When Hedley & Hull described their *Ischnochiton intermedius* from Norfolk Island they observed: "This shell is extremely common, and appears to occupy a position intermediate between *I. crispus*, Reeve, of Australia, and *I. longicymba*, Quoy, of New Zealand. Compared with *I. crispus*, the novelty is more elevated,

has more definitely sculptured lateral areas, and is especially distinguishable from both *I. crispus* and *I. longicymba* by the extremely minute girdle-scales. A similar, if not identical, species was found by Mr. T. Iredale on Raoul or Sunday Island, Kermadec Group." I regret that I cannot coincide with my friends' views in regarding the Kermadec shell as identical with the Norfolk Island species. The differences in this group are slight, but I fortunately have scores of each shell for comparison, and I find the Norfolk Island to be more strongly sculptured, to be a longer, narrower, and higher shell, with the back rounded and no keeling present. The girdle is also broader, whilst the scales on the girdle of the Kermadec shell are even smaller than those on the Norfolk Island one. The posterior valve in *I. intermedius* has the mucro more central and more elevated, the posterior slope being therefore shorter and steeper. Upon dissection I find the posterior tooth of the insertion-plate of the median valves to be very short, at once recalling that of *I. maorianus* (= *I. longicymba*, auct.), and shorter, noticeably, than that of *I. kermadecensis*. I propose to have drawings of these valves made and published later.

A species, somewhat familiar to me, with which Hedley & Hull made no comparison, is *Ischnochiton gryei*, Filhol (= *fulvus*, Suter). This shell is less elevated, has a less prominent posterior valve, and larger girdle-scales.

When Pilsbry separated the New Zealand and Australian species of *Ischnochiton*, which had been previously confused under the name *I. longicymba*, he restricted that name to the New Zealand species, calling it *I. longicymba* (Quoy & Gaimard), and ignoring Blainville's prior *C. longicymba* as indeterminable. Under the present nomenclatural laws such action is inadmissible. Blainville's *C. longicymba* was described from King Island, Bass Strait, and is certainly not the New Zealand shell. Quoy & Gaimard simply used Blainville's name, and did not separate the New Zealand species. For this species, which is well described and figured in Pilsbry's monograph (Man. Conch., vol. xiv, p. 87, pl. xxii, figs. 58-66, 1892), I propose the name

ISCHNOCHITON MAORIANUS, n.sp.

This species differs from *I. crispus* (Reeve) in its larger size, more rounded back, less distinctly striated girdle-scales, and the short posterior tooth of the insertion-plates of the median valves.

*Hab.*—Throughout New Zealand.

Type from Otago Peninsula.

ISCHNOCHITON KERMADECENSIS, var. EXQUISITUS, var. nov. Pl. I, Fig. 2.

After much consideration I have concluded to introduce this shell with varietal rank only. I collected a number of these shells and found them to be fairly constant, but here accept their identity with the common Kermadec species. This variation seems unique in Australasian *Ischnochiton*, as it does not occur in any other species to my knowledge, and I have seen nothing like it from Norfolk Island.

The general coloration of the valves is cream, splashed longitudinally, but irregularly, with very pale orange, the girdle being uniformly black. The whole shell seems less elevated and less sculptured, and the girdle-scales are smaller, but I have decided to disregard these points in view of the known variation of the common darker shells. The internal coloration is whitish, the insertion-plates seem shorter and more delicate, whilst the slits are twelve in the anterior valve and twelve or more in the posterior. The continual recurrence of this peculiarly coloured shell suggests that in time this 'sport' might become fixed. The peculiar coloration met with in many species of *Ischnochiton* and *Chiton* seems to support this theory. Length of type 14, breadth 8 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—With *I. kermadecensis*.

### Family CHITONIDÆ.

#### Genus CHITON.

*Chiton*, Linné, Syst. Nat., 10th ed., p. 667, 1758.

Type (by monotypy!), *Chiton tuberculatus*, Linné.

Four species only were included by Linné in his genus *Chiton*, and as three are unrecognizable the genus must be considered to be based upon the second species only. Following Pilsbry, Australasian students have referred various distinct styles of shell to the genus *Chiton*. In the *Manual of Conchology*, vol. xiv, p. 149, he wrote: "The most natural primary division of *Chiton* is into two groups; one to include all American and some Old World species, in which the mucro is anterior and the scales smooth; the other to include Old World species having the mucro subcentral and the scales striated. As this division is based upon characters not always easy to see, the following divisions into sections is more convenient.

#### Section *Chiton* (restricted).

Median valves having a single slit in each insertion-plate; sinus generally denticulate; scales closely imbricating.

#### Section *Radsia*, Gray.

Median valves having two or more slits in each insertion-plate.

#### Section *Sclerochiton*, Cpr.

Median valves having a single slit in each insertion-plate; teeth of tail valve tending forward; sinus smooth, scales of girdle separated."

This arrangement appears to have been accepted without comment until Thiele (Revision, p. 117) stated his conclusions thus:—

"Genus *Chiton*, Linné.

Section *Radsia*, Gray.

Sub-gen. *Clathropleura*, Tiberi.

Genus *Sclerochiton*, Cpr."

When Pilsbry introduced *Sclerochiton* he wrote: "This section or sub-genus represents a further development of the Acanthopleuroid

characters which some Australasian species of the restricted genus *Chiton* assume. In *Ch. pellis-serpentis*, for example, the mucro is median, the posterior teeth tend forward somewhat, the sinus is smooth or only very obsoletely denticulate, and the girdle-scales are striated and rather separated. In *Sclerochiton* the mucro is slightly more posterior, the teeth slightly more tilted forward; the sinus is smooth, and the girdle-scales still more separated. *Ch. pellis-serpentis* could be placed almost as well in *Sclerochiton* as in *Chiton* s.s.; the necessity of reducing *Sclerochiton* to the rank of a section under *Chiton* will therefore be apparent." It must be remembered that Pilsbry was only conversant with *Sclerochiton* from a study of Carpenter's notes and figures. Since his time the genus has become fairly well known, and the species have never been confused with *Chiton*. *Sclerochiton* is nearly allied to *Acanthopleura* and *Liolophura*. In New Zealand the two commonest Chitons are *Ch. pellis-serpentis*, Quoy & Gaimard, and *Ch. quoyi*, Deshayes<sup>1</sup>; two more dissimilar species, as referable to the same genus, can scarcely be imagined. A third *Chiton* I not uncommonly obtained was *Ch. areus*, Reeve. Three distinct types of shell seemed confused under one generic name.

At the Kermadecs I found two species of 'Chiton' which greatly differed; one recalling *Ch. pellis-serpentis*, Quoy & Gaimard, the other vaguely resembling *Ch. areus*, Reeve. Critical examination proves their only resemblance to be the possession of a scaly girdle, and that the teeth of the insertion-plates are pectinated, but in this latter character they are very different. The dissection of many species of 'Chiton' provided much of interest with regard to many details of their structure, and one point worthy of consideration in the present place (I purpose to deal in much detail in this matter elsewhere) is the number of slits in the anterior insertion-plate. When Pilsbry was discussing *Plaxiphora* (Man. Conch., vol. xiv, p. 313, 1893) he wrote: "It must be understood that although in many groups of Chitons, such as all *Isechnochitoninae* and *Chitoninae*, the number of anterior slits is a character of merely specific importance, the case is far otherwise in those groups in which the slits correspond in number and position with external ribs such as *Nuttallina* and its allies, and the *Mopaliidae*, *Acanthochitidae*, etc. In these groups the number of slits in the anterior insertion-plate is a highly constant generic character, apparent exceptions being readily traceable to the splitting of one or more primary teeth."

I now suggest that when the genera '*Chiton*' and '*Isechnochiton*' are better known, the slitting of the anterior insertion-plate will be found of as much importance as in the genera Pilsbry named. The species similar to *Ch. areus*, Reeve, have been separated by Thiele as a sub-genus of *Chiton*, his conclusions being based on anatomical study.

<sup>1</sup> The correct name of this species is *Amaurochiton glaucus*, Gray (Spicilegia Zoologica, pt. i, p. 5, 1828): this name was rejected by Pilsbry as he concluded the description was inadequate and the type lost. I find the type is preserved in the British Museum, and, moreover, that it was recognized by Carpenter as well as other investigators, notes to this effect being inscribed upon the back of the type tablet.



The name chosen by Thiele was *Clathropleura*, Tiberi, the type of which is given as *Ch. siculus*, Gray. It might be noted that at one time *Ch. cereus*, Reeve, was considered synonymous with that species. The sub-genus '*Clathropleura*' is well represented in Australasian waters, and the dissection of many species shows that the anterior insertion-plate is normally eight-slit; this is very constant, any variation obviously being due to intersplitting. It is assuredly of no import that the external sculpture of the anterior valve is more or less than eight-ribbed. For these I propose (*infra*) to use *Rhyssoplax* generically, and would state that whether the species is heavily sculptured like *Ch. canaliculatus*, Quoy & Gaimard, and *Ch. rauhensis*, Hedley & Hull, or practically smooth, as *Ch. translucens*, Hedley & Hull, the internal structure is exactly comparable.

If *Ch. pellis-serpentis*, Quoy & Gaimard, be now examined, it will be found to differ in every detail. The shell is quite differently sculptured; the scales are more solid and of a different character and more loosely placed on the girdle; the insertion-plates are coarsely pectinate, of quite unlike appearance, the sinus scarcely appreciably denticulate, and *the anterior insertion-plate is never eight-slit*, twelve slits probably being the normal number.

The reference of *Ch. pellis-serpentis*, Quoy & Gaimard, to a distinct genus is the only course consistent with accuracy. It cannot be considered congeneric with the species of *Rhyssoplax*, and it cannot be ranked as a sub-genus of *Chiton*, as it is too different in every way. Pilsbry's comparison of this species with *Acanthopleura* is much nearer the truth, but the intervention of *Sclerochiton* disconnects it rather widely from that genus. For this species alone Thiele introduced *Sypharochiton*, and therefore in this place the generic names *Rhyssoplax* and *Sypharochiton* will displace the familiar '*Chiton*'.

#### Genus RHYSSOPLAX, Thiele.

*Rhyssoplax*, Thiele, Das Gebiss der Schnecken, vol. ii, p. 368, 1893.

Type (by monotypy), *Rhyssoplax jancirensis* = *Chiton affinis*, Issel.

In the Revision, Thiele admits the shells associated with, as regards shell characters, *Ch. olivaceus*, Spengler, as constituting a sub-generic group, and for these he uses *Clathropleura*. The group is well defined, and I would recognize it as a distinct genus, and would have used Thiele's name, but upon investigation this usage is found impossible. *Clathropleura* was introduced by Tiberi in the Bull. Soc. Malac. Ital., vol. iii, p. 136, 1877, as a sub-genus of *Chiton*. No diagnosis is given, but three species are cited, *Ch. levis*, *Ch. corallinus*, and *Ch. sulcatus*. No authorities are given for these specific names, and in Das Gebiss der Schnecken, vol. ii, p. 367, 1893, Thiele used this name and selected *Ch. siculus*, Gray, as type.

Upon reference to the British Museum (Nat. Hist.) copy of the Bull. Soc. Malac. Ital., 1877, a peculiar complication is seen to occur. Tiberi's sub-genus, as above noted, contained three species. On p. 143 *Ch. levis*, Pennant, is noted, and on the same page *Ch. corallinus* (*Lepidopleurus*), Risso, is discussed. Then, on p. 145, *Ch. sulcatus*

(*Lepidoplurus*), Risso, 1826, is recorded, and as a synonym *Ch. siculus*, Gray, 1831, is included. The wrappers of the parts of the Bull. Soc. Malac. Ital. are preserved and bound in, and it appears that p. 145 was the first page of a new part, which did not appear until 1878. That is, that the original introduction of *Clathropleura* did not include *Chiton siculus*, Gray, as a recognizable constituent. According to the International Rules of Nomenclature, this could not therefore be lawfully designated as type. I here designate *Ch. laevis* (Pennant) Tiberi, as type of *Clathropleura*, and that generic name must fall as a synonym of *Callochiton*, Gray.

There is almost as much difficulty in finding a substitute for *Clathropleura*, Thiele (not Tiberi), and I would use *Rhyssoplax*, Thiele. In *Das Gebiss der Schnecken*, vol. ii, 1893, Thiele carefully described the radulae of species of *Chiton*, and, magnifying the differences observed, introduced many new genera. Having accepted *Clathropleura* for *Ch. siculus*, Gray, and *Ch. affinis*, Issel, he proposed on the next page (p. 368) *Rhyssoplax* for two species identified as *Chiton janeirensis*, Gray, and *Ch. segmentata*, Reeve. On p. 377 he proposed *Anthochiton* for *Ch. tulipa*, Quoy & Gaimard. Sixteen years afterwards in the Revision Thiele explained that the species identifications were mostly wrong, having been made when the study of Chitons was in the dark ages before Pilsbry's monograph so clearly illuminated it. On pp. 2-4 he correlates the names used in 1893 with the correct name as determined by means of his own work based on Pilsbry's monograph. It is there stated that *Rhyssoplax janeirensis* (Gray), Thiele, 1893, and *Rh. segmentata* (Reeve), Thiele, 1893, both refer to the same species, which is none other than *Chiton affinis*, Issel. Further, it is noted that *Anthochiton tulipa* (Quoy and Gaimard), Thiele, 1893, is really *Chiton tulipa*, Quoy & Gaimard. Both these he would class under *Clathropleura* as synonyms, and as that name is untenable I conclude *Rhyssoplax* must be used. It may be argued that *Rhyssoplax*, 1893, is indeterminable, and should date from 1909. I quite agree with Thiele that *Rhyssoplax* cannot be used for *janeirensis*, Gray. If *Rhyssoplax* be post-dated to 1909, the question of the usage of *Anthochiton* at once occurs. That name must be considered as dating from 1893, but since the radular characters given by Thiele for his genus *Rhyssoplax* are peculiar, I am regarding *Rhyssoplax* as dating from 1893, and having priority over *Anthochiton*. It is unfortunate that such a delightful and distinct genus should not be in possession of a name without so many complications. I have noted that *Chiton æveus*, Reeve, from New Zealand, was at one time synonymized with *Ch. siculus*, Gray, and as *Ch. affinis*, Issel, was also so considered, the close relationship of the Austro-Neozelanic species to the genotype is obvious. As noted previously, species referable to the genus *Rhyssoplax* vary from very heavily sculptured forms to absolutely smooth species. I examined a series of *Chiton æveus*, Reeve, and found that the most juvenile specimens were unsculptured, then the sulcations on the pleural areas appeared before the lateral radial ribbing was formed. The following species shows the same method

of growth. This implies that the primitive form was unsculptured, and the sculptured forms are more recent.

It is most interesting from this point of view to study the Australasian *Rhyssoplax* when we find this primitive form surviving unchanged in the species *Chiton translucens*, Hedley & Hull. The next stage is well known by means of *Ch. jugosus*, Gould, *Ch. cori*, Pilsbry, etc., and the third stage by such species as the succeeding one and *Ch. areus*, Reeve. A further development of stronger and more pronounced sculpture still is seen in *Ch. canaliculatus*, Quoy and Gaimard, and *C. vauculusensis*, Hedley & Hull. A still more complicated stage is exemplified by *Ch. limans*, Pilsbry, where, in addition to the production of strong sculpture, the girdle-scales develop, from ordinary convex scales, into abnormal mucronate ones. I have traced this species through the stages noted. An extraordinary and different mode of procedure is that adopted by *Ch. howensis*, Hedley & Hull. This species commences as a normal unsculptured shell, but no pleural sculpture is formed, and, instead of radial ribbing on the end valves and lateral areas of the median valves, concentric ridges are produced. The only other species yet known to be equally aberrant is *Ch. platei*, Thiele (Revision, p. 92, pl. ix, figs. 46-8, 1909), described from the Red Sea, whose radula Thiele has shown to be normal to this group.

*RHYSSOPLAX EXASPERATA*, n.sp. Pl. II, Fig. 13.

Shell of medium size, broadly elongate oval, elevated, not definitely keeled, side slopes nearly straight, girdle scaly. Colour variable, green splashed with lighter or darker being the predominant tints; the green may be very pale or dark; white prevails in a few specimens, but no absolutely uniformly coloured shell was obtained, though practically a white one and a black-brown one were noted. Anterior valve rayed with twenty raised ribs, slightly nodulous; at the outer edge intercalating riblets occur in adult specimens. Median valves have their lateral areas similarly four- or five-ribbed; the pleural areas are sculptured with slanting very closely packed sulci, twelve or more in number, none of which reach the anterior edge of the valve, and vanish before the dorsal area is reached, thus leaving the jugal tract smooth and polished. Posterior valve has the mucro elevated, before the centre, the anterior portion sculptured as the pleural areas of the median valves, the posterior portion as the anterior valve, the ribs being fifteen or sixteen and more nodulous in character. Inside coloration greenish, but varying a little, according to the external coloration. Anterior valve has a slightly projecting insertion-plate regularly cut by eight slits, the teeth beautifully pectinated. Median valves with the insertion-plate one-slit, the sutural laminae low and broad, the sinus narrow and finely denticulate. Posterior plate less projecting than anterior, but more developed at sides than centre; the slits number eleven, but one is disproportionate, whilst the others are fairly equal, thereby suggesting twelve to be the normal number. Girdle covered with small oval scales, very closely imbricating, and regularly finely grooved.

The above description is drawn up from a normal specimen selected as type. Some specimens are almost keeled, with fewer sulci, less slanting, on the pleural areas, whilst sometimes the anterior valve-ribs lacks nodulosity altogether, and in other cases it is well pronounced. A very juvenile specimen, 5 mm. long, is smooth throughout, the surface minutely quincuncially granulose. It recalls *Chiton translucens*, Hedley & Hull. Specimens, 6·5 to 7 mm. long, are still smooth, but there now appear five or six sulci on the pleural areas. In some concentric growth-lines can be observed. These suggest the *Ch. jugosus*, Gould, group, especially *Ch. torrianus*, Hedley & Hull. An older shell, though only 6 mm. long, shows the ribbing on the anterior valve to commence on the outside, fourteen being counted, which extend less than one-third the distance to the apex; the lateral areas are more strongly marked than in the preceding stage, a slight depression indicating the differentiation into ribbing; at the edge of the posterior valve nine nodules mark the beginning of the radial ribs; the pleural areas are sculptured with six clean-cut sulci, which extend across the valve. Specimens, 10 mm. long, in some cases show little advancement on the previous stage, whilst in others they show almost perfectly developed adult sculpture. Length of type 18, breadth 10·5 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—On the underside of clean, smooth stones below low tides.

“On smooth stones just below low-water lived species of *Chiton*, of the *æreus*, Reeve, group. . . . I have written species as I have so far failed to realize how many or how few I have collected. The shells can be separated into three forms of *Chiton*. . . . If these forms could be classed as variations of one species, that would seem best, but then we are confronted with the fact that *C. æreus*, Reeve, and its relations are very constant. . . . Then how should a species of such group commence varying under such restricted conditions as is offered them on such a small area. These forms were all living under absolutely the same conditions, so that I have been forced to suggest that they present convergence of species through the action of identical external conditions.”

Somewhat against my will I here admit only one form, as though when collecting differences easily observable were noted, the dried shells show to me at present no constant characters whereby forms can be diagnosed. Under the heading *Ch. corypheus*, Hedley and Hull, from Norfolk Island, the authors write: “This shell appears to approach *C. discolor*, Souverbie, of New Caledonia, but differs from that species in the fewer radial ribs on the end valves, and the fewer and less anteriorly prolonged sulci in the central areas. *Chiton canaliculatus*, Quoy & Gaimard, from New Zealand, is also related, but is more elevated, and sharper keeled, and has a harsher sculpture. A similar, if not identical, species was found by Mr. T. Iredale on Raoul or Sunday Island, Kermadec Group.” I fully agree with the relationship of *Ch. corypheus*, Hedley & Hull, with *Ch. discolor*, Souverbie, but cannot see any close resemblance in that species to *Ch. canaliculatus*, Quoy & Gaimard, whereas it has a great likeness to

*Ch. æreus*, Reeve, from New Zealand. Hedley & Hull (Rec. Austr. Mus., vol. vii, p. 261, 1909) described *Ch. vauchusensis* from Port Jackson, which, though they did not note it, might have been compared with *Ch. canaliculatus*, Quoy & Gaimard, but neither much recall the present species or *Ch. corypheus*, Hedley & Hull.

The Kermadec species I have called *exasperata* on account of the variability of the shells, and my inability to account for it. It is very close indeed to *Ch. corypheus*, Hedley & Hull, but superficially the Kermadec shell has the ribbing on the anterior and posterior valves less nodulous, which is also the case with the lateral area sculpture of the median valves. Closer examination shows the scales on the girdle to be smaller in the Kermadec species, whilst the sulci on the pleural areas of the median valves are weaker. Internally, as was anticipated, little distinction can be seen, but the sinus in the Kermadec shells is noticeably narrower. I should consider that very probably these two are only subspecifically distinct, but, as I am continuing my investigations into this group, I am introducing my Kermadec shell as a species. From *Ch. æreus*, Reeve, my Kermadec species is easily separated by its much less size, much smaller girdle-scales, more closely spaced sulci on the pleural areas of the median valves, etc. *Ch. discolor*, Souverbie, is also a large species, whilst *Ch. suteri*, Iredale, from New Zealand, has widely spaced sulci and *glossy* girdle-scales.

#### Genus SYPHAROCHITON.

*Sypharochiton*, Thiele, Das Gebiss der Schnecken, vol. ii, p. 365, 1893.

Type (by monotypy), *Chiton pellis-serpentis*, Quoy & Gaimard.

#### SYPHAROCHITON THEMEROPIS, n.sp. Pl. II, Fig. 14.

Shell small, oval, elevated, keeled, side slopes almost straight, valves beaked, girdle scaly. Colour black; majority of specimens considerably eroded. Anterior valve with sixteen to twenty strictly radial rows of separated tubercles, the intervals minutely pustulose, the pustules being flat-topped and circular. Median valves with their lateral areas showing three or four separated tuberculose radial rows, the intervals pustulose; the pleural areas regularly pustulose, with no arrangement whatever into longitudinal rows. Posterior valve with the mucro elevate, sub-central, slightly anterior, the posterior slope faintly convex. The anterior portion is sculptured as the pleural areas of the median valves, the posterior as the anterior valve with few strictly radial rows of separated tubercles. Inside coloration dark blue-green. Insertion-plate of anterior valve with ten to twelve slits, the teeth coarsely pectinated and thick; the plate short, but somewhat projecting, and the slits irregular. Teeth pale green. Median valves have the insertion-plate one-slit, the posterior tooth short and stopping very abruptly before reaching the lateral edge of the valve. The sutural laminae are pale green, rounded, low, and widely separated; the tegmentum generally approaches between, but, when the plate is recognizable, it is seen to be strongly denticulate.

Posterior valve with the plate very short and somewhat thrown backward; the slits, ten to twelve in number, are very irregular, while the teeth are thick and coarsely pectinate. The girdle is covered with medium size, rounded, a little separated, deeply grooved scales. The grooves number five to seven on a scale. This description is drawn up from a young shell, as old shells are too much eroded for any sculpture to be determined, save the ends of the radial rows of tubercles; such are more elevated than younger shells. Length of type 9, breadth 5 mm. Length of largest specimen 17·5, breadth 10·5 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—In crevices of rocks between tides. “A *Chiton* was procured which had developed most peculiar habits; it lived in crevices of rock between tide-marks, huddling together, half a dozen being found one upon another, so that some did not touch the rock at all. This species was entirely black, and allied to *pellis-serpentis*, Q. & G.”

Hedley & Hull, having described *Chiton funereus* from Lord Howe Island and Norfolk Island, write: “A similar, if not identical, species was found by Mr. T. Iredale on Raoul or Sunday Island, Kermadec Group.” I think that in this case the words “if not identical” have slipped in by accident, as my friends had my shell for comparison, and there is only a slight superficial resemblance between the two.

*Sypharochiton themeropsis* differs from *Ch. funereus* in colour, shape, sculpture, girdle-scales, and internal structure. *S. themeropsis* is a heavy crass shell, whilst *Ch. funereus* is a delicately formed species; the former is always dead black, the latter varies from black to light brown, green, striped forms, etc.; the former is a somewhat elongate oval, the latter is a very broad oval; in the former the anterior valve is radially rowed with tubercles, the rows very distinct and widely separated; in the latter the tubercles are smaller, much more closely packed, and no distinct rows appear; in the former the pustules on the pleural areas of the median valves never show lineal arrangement; in the latter this is generally the case. The girdle-scales in *S. themeropsis* are deeply grooved with a few grooves; in *Ch. funereus* the girdle-scales are finely striate.

The dissected specimens compared show that in this state no confusion is possible; in the Kermadec shell the insertion-plates are comparatively long, with thick coarsely pectinated teeth, whilst in *Ch. funereus* the insertion-plates are very degraded, with the teeth very minute, and bearing very fine striæ. The differences are so pronounced as to suggest that *Ch. funereus* can scarcely rank in typical *Sypharochiton*, whilst *S. themeropsis* needs comparison with the type of that genus. *S. themeropsis* can be readily distinguished from *S. pellis-serpentis* (Quoy & Gaimard) by its smaller size, grooved girdle-scales, and lack of longitudinal sculpture on the pleural areas of the median valves. *S. sinclairi* (Gray) differs in its smooth pleural areas and *glossy* girdle-scales of larger size. I always found this diagnostic of this species when collecting, but have not seen it noted; even when the shell is eroded the *glossy* girdle-scales will distinguish it.

Genus LUCILINA.

*Lucilina*, Dall, Proc. U.S. Nat. Mus., 1881, p. 290.

Type (by monotypy), *Chiton confossus*, Gould.

Pilsbry for the Tonicoid Chitons accepted two genera *Tonicia* and *Onithochiton*, but separated these into two distinct sub-families, an altogether artificial and obviously imperfect classification. Thiele has so far amended the case that his conclusions read—

Genus *Tonicia*, Gray.

Sub-genus *Lucilina*, Dall.

Sub-genus *Onithochiton*, Gray.

Section *Onithoplax*, Thiele.

I have no hesitation in accepting the very close affinity of *Tonicia*, *Lucilina*, and *Onithochiton*, but I think that it is best expressed by accepting each as of generic rank. There can be no doubt that Thiele's action in associating these forms is an improvement on Pilsbry's, and it has the additional advantage of being based on examination of the radulæ of the Chitons. As, however, *Onithochiton* is well differentiated by means of its posterior valve lacking teeth, I consider the usage of this as generic should be maintained. I include the genus *Lucilina* to note that it lived at the Kermadecs, small valves being not uncommonly met with in shallow water dredgings. One specimen was obtained from a piece of coral pulled out of 6 feet of water at low tide, but I refrain from describing it; too many immature specimens have been lately described, and I do not think that many writers have studied the long series of juveniles that is necessary to understand the great changes that take place between the juvenile and adult in many species.

Genus ONITHOCHITON, Gray.

*Onithochiton*, Gray, Proc. Zool. Soc., 1847, p. 65.

Type (by subsequent designation, Gray, 1847), *Chiton undulatus* = *Onithochiton filholi*, Rochebrune.

It seems worthy of record that at the place cited, Gray introduced the genus *Onithochiton* with the diagnosis: "The hinder valve with a produced terminal apex; plate of insertion entire, rounded; valves thick; mantle covered with spines, bristles, or chaff-like scales." On p. 67 is noted: "This genus (*Acanthopleura*) gradually passes to *Onithochiton*," and on p. 68 we have given—

"ONITHOCHITON.

<i>O. gaimardi</i> . . .	<i>Chiton gaimardi</i> , Blainv., 546.
<i>O. hirtosus</i> . . .	<i>Chiton hirtosus</i> , Blainv., 546.
<i>O. undulatus</i> . . .	<i>Ch. undulatus</i> , Van Diemen's Land."

Later, typifying the genera of Mollusca, Gray (same Proceedings, p. 169) wrote:—

"*Onythochiton*, Gray, 1847 . . . *Ch. undulatus*."

Since that date it has been generally accepted that *Onithochiton* was introduced for *Ch. undulatus*, Quoy & Gaimard. Two points are noticeable; throughout the paper quoted Gray constantly referred to Quoy & Gaimard, and always noted them as authors save in this case; also Quoy & Gaimard described their shell from New Zealand, and it is not known from Tasmania, though Gray recorded it as collected there, and, at the time Gray wrote, four species had been proposed bearing the name *Ch. undulatus*, and it is impossible at this time to know which one Gray intended. To retain the generic *Onithochiton* in the sense now used, we must make use of the argument that *Ch. gaimardi* and *Ch. hirtosus*, Blainville, were species unknown to Gray, save from literature, whereas apparently he had a specimen of *Ch. undulatus* before him as he notes a locality, "Van Diemen's Land." When H. & A. Adams prepared the *Genera of Recent Mollusca* they restricted *Onithochiton* to the *Ch. undulatus*, Quoy and Gaimard, group, and rejected from it *Ch. gaimardi* and *Ch. hirtosus*, Blainville.

In the Proc. Malac. Soc., vol. ix, pp. 153-4, 1910, I made some comments on New Zealand *Onithochitons*, and, accepting Pilsbry's dictum regarding preoccupied names, which is now known to be incorrect, I admitted Quoy & Gaimard's specific name *undulatus* for the common species. As, however, that name is preoccupied, the common New Zealand *Onithochiton* must be now known as *Onithochiton filholi*, Rochebrune. The synonymy and species will remain as given in my paper quoted.

ONITHOCHITON OLIVERI, n.sp. Pl. II, Fig. 11.

Shell of medium size, rather broadly oval, slightly keeled, girdle densely spiculose. Coloration variable; dark green with lighter marblings being normal; one small shell is dark chocolate varied with cream and pink, whilst another is bright vermilion with cream markings. The whole shell is absolutely smooth and glossy, a few growth-lines only showing, the lateral areas of the median valves being indicated by a slight elevation. On the anterior valve twenty to twenty-five irregular radiating rows of eyes, about ten eyes to a row, can be counted. On the lateral areas one row, often doubled and trebled, can be noted. Inside coloration pinkish-white; the anterior valve with two reddish-brown marks on posterior edge; the first median valve with a large red-brown blotch similarly placed, which is more or less extensive on the succeeding valves, but absent from the posterior valve. Anterior valve with projecting plate regularly eight-slit, the teeth beautifully pectinate. Median valves with large sutural laminae, higher near the sinus, which is cleanly denticulate. Insertion-plate one-slit and pectinate. Posterior valve with the insertion-plate reduced to a callus, beyond which the tegmentum extends. Girdle covered with long sharp-pointed, glassy spikes. Length of type 24, breadth 15 mm.

*Hab.*—Sunday Island, Kermadec Group.

*Station.*—Living in crevices of rocks between tide-marks.



This species is named after Mr. W. R. B. Oliver, one of the members of the expedition, who collected most of the living specimens on Meyer Island.

*Remarks.*—This species is closely related to *Onithochiton filholi*, Rochebrune (= *undulatus*, auct.), from which it is at sight separable by the girdle characters. Every specimen found was perfectly smooth, and showed no approach to the ribbing which caused the 'semisculptus' confusion in the case of the Neozelanic species.

The types, which have been figured, are to be deposited in the Canterbury Museum, Christchurch. The figures here given show these shells which have not been dissected; I am having detail figures prepared which will be published later in conjunction with others covering the comparative questions raised.

## 2. COMPARATIVE REVIEW.

My remarks in the Proc. Malac. Soc., vol. ix, p. 160, 1910, read: "The noticeable features [of the Neozelanic Chiton fauna] are the poverty of species of *Ischnochiton*, the large size of the *Acanthochites*, the distinct nature of the *Plaxiphora* and *Onithochiton*, and the presence of the genus *Eudoxochiton*. The Chitons collected at Sunday Island agree in the majority of these items, yet possess so many peculiarities that they deserve some little notice." When making this statement I had been contrasting the Chiton faunas of the marine biological divisions of Australia, and I afterwards noted the nature of the Lord Howe and Norfolk Island Chitons from my examination of my friend Mr. Hull's collection. These have now been fully reported upon, and I propose to make comparisons with those, and show their essential distinction, though some apparent close relationship is at first noted. A tabulation of the species recorded from each group will aid in following my remarks.

KERMADECS.	LORD HOWE ISLAND.	NORFOLK ISLAND.
<i>Parachiton mestayeræ</i>	—	—
<i>Lepidopleurus subtropicalis</i>	<i>L. eatenatus</i>	<i>L. norfolciensis</i>
<i>Eudoxochiton perplexus</i>	—	—
<i>Eudoxochiton imitator</i>	—	—
<i>Plaxiphora mixta</i>	—	—
( <i>Acanthochites</i> sp.)	<i>A. leuconotus</i>	—
( <i>Acanthochites</i> sp.)	<i>A. approximans</i>	<i>A. approximans</i>
( <i>Cryptoconchus</i> sp.)	—	—
<i>Ischnochiton kermadecensis</i> , var. <i>exquisitus</i>	—	<i>I. intermedius</i>
<i>Sypharochiton themeropsis</i>	<i>Ch. (? S.) funereus</i>	<i>Ch. (? S.) funereus</i>
<i>Rhyssoplax exasperata</i>	<i>Ch. (R.) howensis</i>	<i>Ch. (R.) corypheus</i>
( <i>Lucilina</i> sp.)	—	—
<i>Onithochiton oliveri</i>	<i>O. discrepans</i>	—

The merest glance will show that whereas from Lord Howe Island six species are recorded, from Norfolk Island there are only five. I make the Kermadec Chiton fauna to total nine species and one variety, with evidence of four others. Further study will show that in the nine species three additional genera are represented, whilst in

the four recognized, but unnamed, two further additional genera occur. When, however, the species are separately contrasted, the differences become more marked still. I will take them in the order of the tables above given, and this will conduce to facile reference.

*Parachiton mestayeræ*, Iredale, cannot be compared, as it is more than probable that this genus extends all over this part of the Pacific Ocean, the only other species of the genus, *P. acuminatus*, Thiele, having been described from Duke of York Island. There is a small species of *Lepidopleurus* found on each group, and, though they seem closely allied, very little stress can be laid upon this, as the small species of *Lepidopleurus* vary little over large areas. The Kermadec species is very distinct, as is that from Lord Howe Island. Hedley and Hull compare the Norfolk Island species with the New South Wales form, whilst it clearly recalls to me the Kermadec shell.

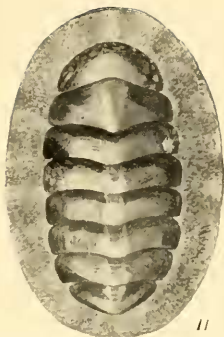
I have differentiated two forms of *Eudoxochiton* from the Kermadecs, and this genus is otherwise restricted to New Zealand with two species, and nothing nearly related occurs on Norfolk Island, Lord Howe Island, or the Australian continent. In consequence I lay great stress on this occurrence. A species of *Plaxiphora* was also found at the Kermadecs, whilst no form referable to the family was obtained at Lord Howe Island or Norfolk Island. The Kermadec species was, moreover, referable to the sub-genus *Maorichiton*, which is common throughout New Zealand, but which does not occur in Australia. This seems of great import to me.

From Norfolk Island a species of *Acanthochites* was recorded, which is considered by Hedley & Hull close to the Australian *A. granostriatus*, Pilsbry. The species also occurred on Lord Howe Island, where it was accompanied by another species which Hedley & Hull compare with the Australian *A. costatus*, Adams & Angas. It should be noted that we do not yet know the small species of *Acanthochites* from New Caledonia and Fiji, and the New Caledonian *A. tridaena*, Rochebrune, would seem to belong to the *A. costatus* group, whilst we know species not unlike *A. granostriatus*, Pilsbry, from North of Australia. Two small species of *Acanthochites* were noted as valves in dredgings at the Kermadecs, but no complete specimen was obtained. Of peculiar interest, however, was the collection of a valve which I refer to *Cryptoconchus*, a genus almost peculiar to New Zealand. The genus *Ischnochiton* was not represented at Lord Howe Island, though a species was found at Norfolk Island, and I have separated the Kermadec form, which looks so similar, that Hedley & Hull considered it identical. The characters in this group, however, are so slight, that I do not feel justified in advocating their identity. The absence of the genus *Ischnochiton* from Lord Howe Island cannot be explained at present, but it may be that this genus is also absent or ill-represented in New Caledonia.

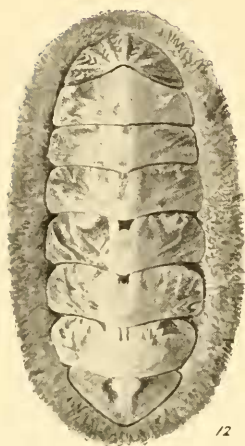
The Neozelanic *Sypharochiton* is represented at the Kermadecs by the form I have called *S. themeropsis*. A species which recalls this occurs both at Lord Howe Island and Norfolk Island. Hedley and Hull remarked that the Kermadec species might be identical, but the internal features are very different, and I feel very doubtful whether



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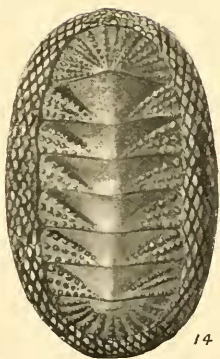
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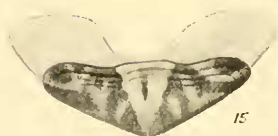
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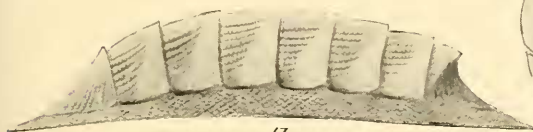
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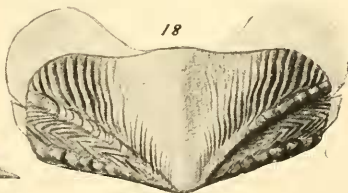
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Roland Green del.

CHITONS FROM THE KERMADEC ISLANDS.